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Overdiagnosis of Urinary Tract Infection and Underdiagnosis of Sexually Transmitted Infection in Adult Women Presenting to an Emergency Department

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Urinary tract infections (UTIs) and sexually transmitted infections (STIs) are commonly diagnosed in emergency departments (EDs). Distinguishing between these syndromes can be challenging because of overlapping symptomatology and because both are associated with abnormalities on urinalysis (UA). We conducted a 2-month observational cohort study to determine the accuracy of clinical diagnoses of UTI and STI in adult women presenting with genitourinary (GU) symptoms or diagnosed with GU infections at an urban academic ED. For all urine specimens, UA, culture, and nucleic acid amplification testing for *Neisseria gonorrhoeae*, *Chlamydia trachomatis*, and *Trichomonas vaginalis* were performed. Of 264 women studied, providers diagnosed 175 (66%) with UTIs, 100 (57%) of whom were treated without performing a urine culture during routine care. Combining routine care and study-performed urine cultures, only 84 (48%) of these women had a positive urine culture. Sixty (23%) of the 264 women studied had one or more positive STI tests, 22 (37%) of whom did not receive treatment for an STI within 7 days of the ED visit. Fourteen (64%) of these 22 women were diagnosed with a UTI instead of an STI. Ninety-two percent of the women studied had an abnormal UA finding (greater-than-trace leukocyte esterase level, positive nitrite test result, or pyuria). The positive and negative predictive values of an abnormal UA finding were 41 and 76%, respectively. In this population, empirical therapy for UTI without urine culture testing and overdiagnosis of UTI were common and associated with unnecessary antibiotic exposure and missed STI diagnoses. Abnormal UA findings were common and not predictive of positive urine cultures.

Urinary tract infections (UTIs) are diagnosed in over 1 million emergency department (ED) visits each year in the United States (1). Sexually transmitted infections (STIs) are also commonly diagnosed in the ED. The Centers for Disease Control and Prevention estimates that nearly 20 million new STIs occur annually, many of which go undiagnosed and unreported (2). Lower UTIs and many STIs have overlapping symptomatology, including the traditional UTI symptoms of dysuria, frequency, and urgency. In addition, abnormal urinalysis (UA) findings of positive leukocyte esterase and pyuria are common in both UTIs and STIs (3–6). Thus, distinguishing between these infections can be challenging.

Previous studies in ED settings evaluating women diagnosed with UTIs have demonstrated that only about 50% will have a positive urine culture and 10 to 50% will have an STI (5, 7–10). These studies suggest that UTIs are overdiagnosed and STIs are underdiagnosed in the ED. However, previous studies in the ED setting have several limitations. First, some studies (5, 8) used a cutoff of $\geq 10^4$ CFU/ml of a single uropathogen to define a positive urine culture, which may be inappropriately high for some organisms and populations (11, 12). Thus, the incidence of UTI may have been underestimated. Second, some studies may have underdiagnosed STIs because they did not use sensitive molecular diagnostic tests for STIs (6), and no previous studies used nucleic acid amplification testing (NAAT) for *Trichomonas vaginalis*. Finally, most previous studies included only women with traditional urinary symptoms and some included predominantly adolescents. In our institution, we have reported that UTIs are often diagnosed in adult women presenting to the ED with no traditional urinary symptoms (e.g., with lower abdominal pain or genital tract symptoms) (13).

Here, we examined the frequency of overdiagnosis of UTI and underdiagnosis of STI in adult women presenting with genitourinary (GU) symptoms or diagnosed with GU infections at an urban academic ED. All urine specimens were subjected to UA, culture, and NAAT for *Neisseria gonorrhoeae*, *Chlamydia trachomatis*, and *T. vaginalis*. We calculated the performance characteristics of the UA for prediction of a positive urine culture in this population.

MATERIALS AND METHODS

Setting and study design. MetroHealth Medical Center is an academic, urban, level 1 trauma center averaging 90,000 to 100,000 ED visits annually. In accordance with ED triage protocol, a UA is ordered for all women presenting with GU symptoms or abdominal pain. For a 2-month period, ED visits by women between the ages of 18 and 65 years who had a UA sent to the lab during the preceding 24 h were reviewed Monday through

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Friday. Visits by these women were included in this study if they presented with GU symptoms or were treated for GU infections. Women were excluded if they were unable to provide a history, if they resided in a skilled-nursing facility, if their UTI treatment was a continuation from a UTI diagnosis prior to the ED visit, or if they presented with a complicated UTI, including those with urinary catheters and those with structural or functional abnormalities of the urinary system. Pregnant women at <20 weeks of gestation were included, as were patients with diabetes, as long as they had no structural or functional abnormality of the urinary system. The MetroHealth Medical Center Institutional Review Board approved this study.

Patient characteristics. Demographics, medical conditions, symptoms, physical examination findings, laboratory data, and provider diagnoses and treatments were independently obtained through medical record review by two of us (M.T. and M.H.) using a standardized data collection form. Any discrepancies in data collection were corrected by additional review. Provider diagnoses included diagnoses made by the ED providers at the time of the visit, as well as additional diagnoses and treatment, often based on laboratory test results, given by the ED providers within 7 days of the visit. The subject's medical record was reviewed 8 weeks after the ED visit to identify if changes in treatment or adverse events related to the initial ED visit occurred.

Laboratory testing. UA was performed as part of routine care with the Clinitek ATLAS automated urine chemistry analyzer (Bayer Healthcare, Tarrytown, NY). Microscopy of a centrifuged urine specimen was automatically performed by a laboratory technician if a greater-than-trace amount of protein, blood, or leukocyte esterase was present on UA. Midstream urine cultures ordered as part of routine care were plated with a 0.001-ml loop on blood and MacConkey agars and reported as positive if there was growth of one or two uropathogens at $>10^4$ CFU/ml, in accordance with our institution's clinical laboratory protocol at the time. During the study period, NAAT for *N. gonorrhoeae* and *C. trachomatis* was available for clinical use but NAAT for *T. vaginalis* was not. Our institution's clinical laboratory reported *T. vaginalis* if it was seen on either urine microscopy or a vaginal wet mount. During this study, all urine specimens sent for UA testing from the ED were refrigerated for 24 h after receipt in the clinical laboratory. For women meeting the inclusion criteria, study personnel plated an aliquot of urine for culture on blood and MacConkey agars with a 0.01-ml loop within 24 h of collection, if a urine culture was not already ordered by ED providers. For these study urine cultures, uropathogens were identified if there was growth of $>10^2$ CFU/ml. An additional aliquot of urine was pipetted into appropriate tubes and frozen for later NAAT (Hologic Aptima Combo2 and Aptima *T. vaginalis* assays) for *N. gonorrhoeae*, *C. trachomatis*, and *T. vaginalis*. NAAT of all samples for *T. vaginalis* was performed. NAAT for *N. gonorrhoeae* and *C. trachomatis* was performed only if testing had not already been ordered by ED providers. The research laboratory results were not shared with the ED providers.

Definitions. For this study, a positive urine culture was defined as the isolation of one or two uropathogens in pure culture at a growth level of $\geq 10^3$ CFU/ml, or if normal urogenital skin flora was also isolated, the uropathogen had to be at a growth level >10 times that of organisms consistent with normal urogenital skin flora. A negative urine culture was defined as no growth at $\geq 10^3$ CFU/ml or growth of urogenital/skin contaminants only. A contaminated urine culture was defined as the presence of more than two uropathogens in a mixed culture or the presence of one or two uropathogens in a culture at a growth level <10 times that consistent with normal urogenital or skin flora (11, 12, 14). Pyuria was defined as more than five white blood cells per high-power field in a centrifuged urine sample.

Statistical analysis. Data were analyzed with STATA 11 (StataCorp, College Station, TX). The Pearson chi-square test and Fisher's exact test were used for categorical data. The sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and likelihood ratios of individual and combined components of the UA for detection of a positive urine culture were calculated.

TABLE 1 Patient characteristics

Parameter	Value[a]
No. of patients	264
Median age (IQR[b] 25–75), yr	27 (21–37)
Age of ≥50 yr	34 (13)
Ethnicity	
White	82 (31)
African American	105 (40)
Hispanic	38 (14)
Pregnant[c]	24 (9)
Diabetes	24 (9)
History of STI	71 (27)
Postmenopausal[d]	39 (15)
Symptoms[e]	
One or more UTI-related symptoms[f]	175 (66)
One or more UTI-related symptoms without vaginal symptoms[g]	129
One or more traditional UTI symptoms[h]	126 (48)
One or more traditional UTI symptoms without vaginal symptoms	96
Dysuria and frequency	52 (20)
Dysuria and frequency without vaginal symptoms	48
Vaginal symptoms with no UTI-related symptoms	40 (15)
Nonspecific symptoms with no UTI-related or vaginal symptoms	49 (19)

[a] Data are the number (%) of patients, unless otherwise indicated.
[b] IQR, interquartile range.
[c] Twenty of the pregnancies were at ≤14 weeks of gestation, and four were between 15 and 19 weeks of gestation.
[d] Documented postmenopausal status ($n = 33$) or age of >50 years if status not documented ($n = 6$).
[e] No documentation of any UTI-related symptom in 2 patients, no documentation of any traditional UTI symptoms in 27 patients, and no documentation of any vaginal symptoms in 77 patients.
[f] UTI-related symptoms include dysuria, frequency, urgency, hematuria, other urinary symptoms, suprapubic pain, and flank pain.
[g] Vaginal symptoms include vaginal discharge, abnormal vaginal bleeding, vaginal itching, and vaginal lesions.
[h] Traditional UTI symptoms include dysuria, frequency, and urgency.

RESULTS

Two hundred sixty-four women who had a urine sample available and met the inclusion criteria were enrolled in this study. Table 1 shows the characteristics of the study participants. Seventy-one (27%) of them had a prior STI. One-hundred seventy-five (66%) had one or more of the following possible UTI-related symptoms documented: dysuria, frequency, urgency, hematuria, other urinary symptoms, suprapubic pain, or flank pain. One-hundred twenty-six (48%) had one or more traditional UTI symptoms documented, defined as dysuria, frequency, or urgency. Forty (15%) had documentation of vaginal symptoms without any UTI-related symptoms. Vaginal symptoms included vaginal discharge, abnormal vaginal bleeding, vaginal itching, and vaginal lesions. Forty-nine (19%) had documentation of nonspecific symptoms without UTI-related or vaginal symptoms. The presence or absence of any UTI-related symptoms, any traditional UTI symp-

toms, and any vaginal symptoms was not documented in 2 (0.01%), 27 (10%), and 77 (29%) subjects, respectively.

Of the 264 subjects, 152 (58%) were diagnosed by ED providers with a UTI only and 23 (9%) were diagnosed with both a UTI and a genital tract infection (GTI). GTIs included both the specific STI evaluated in this study and other infections of the genital tract. Seventy-five (28%) were diagnosed with a GTI only, and 14 (5%) were diagnosed with conditions other than an infection of the urinary or genital tract. Of the 175 UTI diagnoses, 120 were classified by providers as UTIs, 4 as asymptomatic bacteriuria of pregnancy, 18 as cystitis, and 33 as pyelonephritis. Of the 120 subjects given a generic UTI diagnosis, we inferred a provider diagnosis of cystitis in 94 (78%) given the lack of documented fever, chills, flank pain, or costovertebral angle tenderness.

Microbiologic test results. All 264 subjects had urine cultures performed. One urine sample was obtained via straight catheterization. All others were voided midstream urine specimens. Eighty-six (33%) urine cultures were ordered and performed as part of routine care, with the remainder performed by study personnel. Two hundred fifty-four subjects (96% of the total) had NAAT for *N. gonorrhoeae* and *C. trachomatis* performed, 117 (46%) of whom had this testing ordered and performed as part of routine care, with the remainder performed by local study personnel. Two hundred forty-six subjects (93% of the total) had NAAT for *T. vaginalis* performed, 107 (43%) of whom had this testing performed by Hologic, with the remainder performed by local study personnel. Technical reasons (usually an inadequate amount of urine available for complete testing) prevented completion of NAAT for all subjects. One hundred ten subjects (42%) had wet-mount testing and 95 (36%) had KOH testing ordered by ED providers as part of their routine care.

The results of laboratory testing are shown in Table 2. Of 264 subjects, 104 (39%) had positive urine cultures, 102 (39%) had negative urine cultures, and 58 (22%) had contaminated urine cultures. Twenty-one (8%) subjects received antibiotic therapy within 7 days of the urine culture, 10 of whom had negative urine cultures. Twelve of the 21 subjects with recent antibiotic therapy received antibiotics with no or limited activity against the usual uropathogens, e.g., metronidazole and clindamycin. Of the 117 individual uropathogens isolated from a positive urine culture, 11 (9%) were at a growth level of 1,000 to 9,999 CFU/ml and 106 (91%) were at a growth level of >10,000 CFU/ml. Although not considered a positive culture on the basis of our study definition, 3 of the 178 urine cultures performed through the study with a 0.01-ml loop had uropathogens isolated at a growth level of 100 to 999 CFU/ml; 1 had pure growth of a lactose nonfermenter, 1 had *Escherichia coli* isolated but at a growth level that was less than that of concomitant urogenital flora, and 1 had *Streptococcus agalactiae* isolated but at a growth level that was less than that of concomitant urogenital flora. Sixty (23%) subjects had at least 1 STI test positive for *N. gonorrhoeae*, *C. trachomatis*, or *T. vaginalis*. Of the 246 subjects with complete testing, 72 (29%) had negative urine cultures and negative STI test results.

Table 3 shows the results of urine cultures and STI tests, stratified by documented symptoms. Urine cultures were more often positive in women without vaginal symptoms who had both dysuria and urinary frequency; however, even among these women with traditional UTI symptoms, urine cultures were positive in only 67% of the cases and STI tests were positive in 10%.

Diagnostic accuracy of provider diagnoses. Figure 1 shows the results of urine cultures and STI tests, stratified by provider diagnoses. Of 175 subjects diagnosed with UTI by providers, 100 (57%) were treated without performing a urine culture during routine care. Combining routine care and study-performed urine cultures, only 84 (48%) of the subjects diagnosed with a UTI had a positive urine culture, 54 (31%) had a negative urine culture, and 37 (21%) had a contaminated culture. The frequency of overdiagnosis of UTI was 52% when contaminated cultures were considered negative and 39% when contaminated cultures were excluded from the evaluation.

Of 1,021 total days of antibiotic therapy prescribed for UTIs, 311 (30%) were prescribed for 54 subjects with negative urine

TABLE 2 Laboratory test results

Test result	No. of patients/no. tested (%)
Positive urine culture	104/264 (39)
1 uropathogen only	81/104 (78)
Escherichia coli	58
Klebsiella species	6
Proteus species	4
Streptococcus agalactiae	4
Staphylococcus saprophyticus	2
Enterobacter species	2
Citrobacter species	3
Enterococcus species	1
Staphylococcus aureus	1
2 uropathogens only	12/104 (12)
Escherichia coli	13
Klebsiella species	1
Candida albicans	1
Streptococcus agalactiae	2
Acinetobacter species	1
Enterobacter species	1
Lactose fermenter	1
Enterococcus species	2
Staphylococcus aureus	2
1 or 2 uropathogens at >10× background[a]	11/104 (10)
Escherichia coli	5
Klebsiella species	1
Streptococcus agalactiae	1
Enterococcus species	5
Negative urine culture	102/264 (39)
Contaminated urine culture	58/264 (22)
Positive STI test[b]	63
Neisseria gonorrhoeae	2/254 (1)
Chlamydia trachomatis	19/254 (7)
Trichomonas vaginalis[c]	42/254 (16)
Other positive genital tract test	40
Yeast[d]	13/111 (12)
Herpes simplex virus	2/4 (50)
Clue cells (≥20%)	25/110 (23)

[a] One patient had two uropathogens at >10× the background.
[b] Three patients had two positive STI tests; 60 patients overall had at least one positive STI test.
[c] Two patients were positive for *T. vaginalis* in the absence of *T. vaginalis* NAAT, one identified by urine microscopy and the other on a wet mount. Two patients had a negative *T. vaginalis* NAAT with *T. vaginalis* seen on urine microscopy.
[d] One KOH test was done without a wet mount.

TABLE 3 Urine culture and STI test results stratified by symptoms

Symptom(s)	Positive urine culture	Negative urine culture	Contaminated urine culture	Positive STI test[a]
≥1 possible UTI-related symptoms[b]	71/175 (41)[c]	66/175 (38)	38/175 (22)	42/161 (26)
≥1 possible UTI-related symptoms without vaginal symptoms	62/129 (48)	43/129 (33)	24/129 (19)	11/85 (13)
≥1 traditional UTI symptoms[d]	65/126 (52)	40/126 (32)	21/126 (17)	23/112 (21)
≥1 traditional UTI symptoms without vaginal symptoms	56/96 (58)	27/96 (28)	13/96 (14)	11/85 (13)
Dysuria and frequency	34/52 (65)	12/52 (23)	6/52 (12)	5/44 (11)
Dysuria and frequency without vaginal symptoms	32/48 (67)	11/48 (23)	5/48 (10)	4/40 (10)
Vaginal symptoms only[e]	9/40 (22)	22/40 (55)	9/40 (22)	9/38 (24)
Nonspecific symptoms without any UTI-related or vaginal symptoms	24/49 (49)	13/49 (27)	12/49 (25)	9/47 (19)

[a] Denominator includes only subjects with complete NAAT for *N. gonorrhoeae*, *C. trachomatis*, and *T. vaginalis*.
[b] UTI-related symptoms include dysuria, frequency, urgency, hematuria, other urinary symptoms, suprapubic pain, and flank pain.
[c] Number of patients/number tested (%).
[d] Traditional UTI symptoms include dysuria, frequency, and urgency.
[e] Vaginal symptoms include vaginal discharge, abnormal vaginal bleeding, vaginal itching, and vaginal lesions.

cultures. Of these subjects treated for UTIs with negative urine cultures, seven returned to the ED or presented to an outpatient clinic with persistent symptoms; two were subsequently diagnosed with nephrolithiasis, and five had no definitive diagnosis determined. Three of these subjects were called back to the ED for treatment of an STI, including two for *C. trachomatis* and one for *T. vaginalis*. On the basis of medical record review, no subjects presented with adverse events due to antibiotic treatment, such as yeast infection, rash, or gastrointestinal side effects.

Of the 89 subjects not diagnosed with UTI by providers, 20 (22%) had a positive urine culture, 11 with Gram-negative organisms (mostly *E. coli*) and 9 with Gram-positive organisms, including *S. agalactiae*, *Enterococcus* species, and *Staphylococcus aureus*. During 8 weeks of follow-up, none of these subjects had complications of an untreated UTI. Of note, 9 of these 20 subjects treated for diagnoses other than a UTI received an antibiotic with possible activity against the uropathogen isolated.

Sixty subjects (23%) had one or more positive STI tests. Twenty-two (37%) did not receive treatment for an STI within 7 days of the ED visit. The 24 missed STI diagnoses (2 patients had 2 positive STI tests and were untreated) included 12 cases of *C. trachomatis* infection, 11 cases of *T. vaginalis* infection, and 1 case of *N. gonorrhoeae* infection. Fourteen (64%) of the 22 subjects were diagnosed with a UTI only instead of an STI, 2 were diagnosed with a UTI and another GTI, 5 were diagnosed with another GTI, and 1 had flank pain and was diagnosed with pneumonia.

Urinalysis results. Table 4 shows the performance characteristics of individual and combined components of the UA for detection of positive urine cultures. Two hundred forty-three (92%) subjects had an abnormal UA defined as a greater-than-trace leukocyte esterase level, a positive nitrite test result, or pyuria defined as more than five white blood cells per high-power field. The presence of an abnormal UA (a greater-than-trace leukocyte esterase level, a positive nitrite test result, or pyuria) had a sensitivity of 95%, a specificity of 10%, a PPV of 41%, and an NPV of 76%. Of the 40 patients with a positive STI without a positive urine culture, 33 (82%) had an abnormal UA, all because of a positive leukocyte esterase or pyuria result.

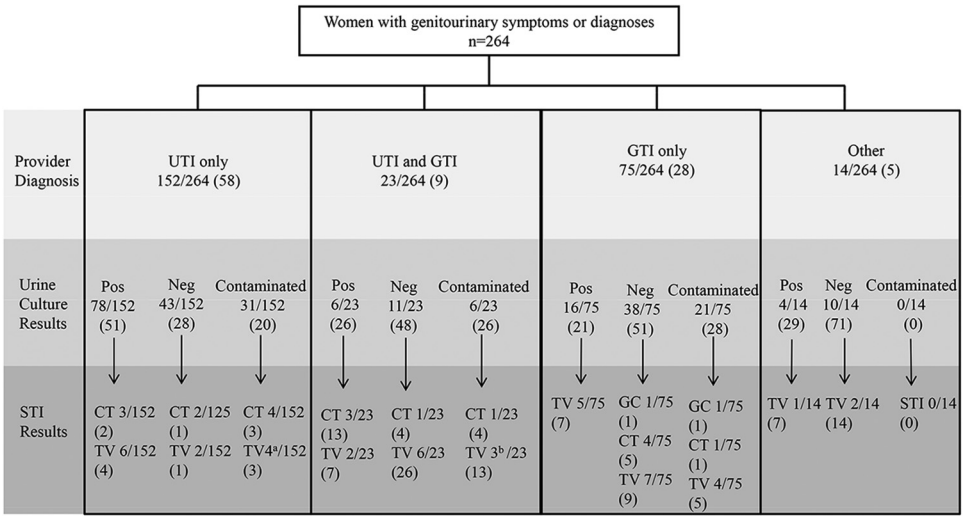

FIG 1 Urine culture and STI testing results stratified by provider diagnosis. Data are number of patients positive/number of patients tested (%), unless otherwise indicated. Pos, positive; Neg, negative; CT, *C. trachomatis*; TV, *T. vaginalis*; GC, *N. gonorrhoeae*. The superscript letter a indicates that two patients had both *C. trachomatis*- and *T. vaginalis*-positive tests, and the superscript letter b indicates that one patient had both *C. trachomatis*- and *T. vaginalis*-positive tests.

TABLE 4 Performance characteristics of leukocyte esterase, nitrite, and pyuria tests for detection of significant bacteriuria[a]

Result(s) (no. of patients)	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	LR^{+}[b]	LR^{-}[c]
LE[d] positive (187)	78	34	43	70	1.2	0.6
Nitrite positive (50)	22	87	72	42	1.7	0.90
Pyuria positive[e] (186)	86	31	46	77	1.2	0.4
LE and nitrite positive (32)	19	92	62	64	2.6	0.9
LE or nitrite positive, pyuria negative (202)	67	34	41	34	1.0	0.98
LE, nitrite, or pyuria positive (243)	95	10	41	76	1.1	0.5

[a] One or two uropathogens at a growth level of $>10^3$ CFU/ml.
[b] LR^{+}, positive likelihood ratio.
[c] LR^{-}, negative likelihood ratio.
[d] LE, leukocyte esterase.
[e] Five or more white blood cells per high-power field.

DISCUSSION

In women presenting to an urban academic ED with GU symptoms, we found that overdiagnosis of UTI was common, seen in up to 52% of the women, and similar to previously reported UTI overdiagnosis rates of 31 to 57% (7, 8). Underdiagnosis of STI was also common, seen in 37%, although somewhat lower than previously reported rates of 50 to 58% (5, 7–10). Overdiagnosis of UTI was not only a common cause of unnecessary antibiotic use but also contributed to the underdiagnosis of STI, since 64% of the patients with a missed STI were diagnosed as having a UTI instead. An abnormal UA result, seen in 92% of our subjects, was a common finding, poorly predicted the presence of a positive urine culture, and may also have contributed to the overdiagnosis of UTI.

Our findings expand upon the existing literature in several ways. First, we systematically performed STI testing, including NAAT for *T. vaginalis*. Eleven of the 24 missed STI diagnoses were due to *T. vaginalis*. *T. vaginalis* is the most common nonviral STI and is often missed by non-NAAT methods (4, 15). In a recent study including women ≥16 years of age attending a sexually transmitted disease clinic utilizing NAAT methods (14), the overall prevalence of *T. vaginalis* was 27%, with the highest prevalence (34%) in women >40 years of age.

Second, we systematically performed urine cultures and used criteria for a positive urine culture (one or two uropathogens at a growth level of $\geq 10^3$ CFU/ml from a midstream urine sample) that would improve the detection of possibly significant bacteriuria. Although Shapiro et al. (8) defined a positive urine culture as any organism isolated at a growth level of $\geq 10^2$ CFU/ml, they obtained urine samples via straight catheterization. This allowed the detection of low-colony-count bacteriuria, which may be significant in women with urinary symptoms (11); however, neither straight catheterization nor a cutoff of $\geq 10^2$ CFU/ml is part of the current standard clinical practice. A cutoff of 10^3 CFU/ml may be a reasonable compromise between sensitivity in detecting potentially significant bacteriuria in symptomatic women and feasibility for the laboratory in quantifying organisms with the standard 0.001-ml loop, which has a lower limit of detection of 10^3 CFU/ml. Our study, in contrast to others, also included data on rates of contaminated urine cultures, which are not uncommon in clinical practice (17).

Third, our study is a reflection of what happens in current clinical practice in an ED setting including adult women 18 to 65 years of age for whom UTI diagnoses and empirical therapy for UTI are often given even in the absence of any UTI-related symptoms and without a urine culture. Twenty-four percent of the subjects diagnosed with UTIs had no possible UTI-related symptoms documented. Although in several reviews of uncomplicated UTI (3, 18, 19), empirical therapy without a urine culture is recommended for women with suspected uncomplicated cystitis presenting with at least one traditional lower UTI symptom and without vaginitis symptoms or other complicating factors, we noted that empirical therapy without urine culture was often prescribed for subjects without this combination of symptoms. In addition, although we did not prospectively collect data on symptoms, in our study population, the probability of a positive urine culture with one or more traditional UTI symptoms without documentation of vaginal symptoms was only 58%. Similarly, Shapiro et al. (8) found that only 57% of urine cultures were positive for women 18 to 55 years old presenting to the ED without significant vaginal discharge but with one or more traditional urinary symptoms (urinary frequency, dysuria, urgency, or suprapubic pain or pressure). Huppert et al. (5) found that only 26% of adolescent women presenting to the ED with urinary symptoms had a positive urine culture. Even in a selected group of women presenting to several EDs with a history of UTI, irritable-voiding symptoms, and absence of vaginitis and complicating factors, a group comprising only 17% of the women presenting with suspected UTIs, Stein et al. (20) found that only 69% had a positive urine culture. Other etiologies of traditional UTI symptoms without vaginal symptoms would include infection with herpes simplex virus, other viruses, *Mycoplasma genitalium*, and *Ureaplasma urealyticum*, as well as noninfectious causes such as vaginal atrophy, urethral trauma during sexual intercourse or other physical activity, sensitivity to topical perianal products, nephrolithiasis, and psychogenic conditions (21). Thus, based on our data and others, empirical therapy without additional testing based on symptoms alone for women with suspected uncomplicated cystitis, especially in ED settings with high rates of STI, would result in significant rates of unnecessary antibiotic therapy.

Finally we included an evaluation of the performance characteristics of the individual and combined components of the UA to predict a positive urine culture in this population, because on the basis of a previous study (13), we believed that providers relied heavily on UA results to diagnose a UTI. Our finding that the operating characteristics of the UA were poor in this population is consistent with findings by Lachs et al. (12) over 20 years ago highlighting the spectrum bias inherent in the operating characteristics of the rapid dipstick test for UTIs, especially in populations with relatively low prior probabilities of UTI. UA testing

performed as part of a triage protocol for all women with GU and abdominal symptoms likely includes many women with a low probability of UTI. In our study, only 66% of the subjects reported one or more possible UTI-related symptoms. The operating characteristics of UA may also be suboptimal in settings with high rates of STI, as pyuria and a positive leukocyte esterase test result may be seen in patients with *N. gonorrhoeae*, *C. trachomatis*, and *T. vaginalis* infections (4, 11) and in settings in which the rates of contamination with multiple organisms are relatively high, as can be seen in clinical practice (17).

Our study has some limitations. It was performed at a single urban institution with a high prevalence of women with a history of STI and may not be generalizable to other practice settings. Our definition of a positive urine culture included *Enterococcus* species and *S. agalactiae* as uropathogens. Recent data suggest that these organisms may not always represent true bacteriuria (22). In addition, some of our positive urine cultures may represent asymptomatic bacteriuria unrelated to the patient's presenting complaints, which in a nonpregnant women would not require treatment (23). Thus, rates of UTI overdiagnosis may have been higher than we calculated. Twenty-one subjects (8%) received antibiotic therapy within 7 days of the urine culture, which might have resulted in falsely negative urine culture results; however, over half of these subjects received antibiotics with no or limited activity against the usual uropathogens and all had GU symptoms despite the recent antibiotic therapy. Positive STI test results, especially those for *C. trachomatis* and *T. vaginalis*, may also represent asymptomatic infection unrelated to the patient's presenting symptomatology; however, treatment for these infections would be recommended (4). Finally, we did not prospectively collect data on symptoms and signs but rather relied on provider documentation, which may be incomplete or subject to misinterpretation.

On the basis of our data and others, we believe that alternative test-and-treat strategies for managing women with GU and nonspecific abdominal pain in the ED should be evaluated. Specifically, we recommend strategies that both decrease UA testing and increase urine culture and STI testing. First, strategies that eliminate UA testing from triage protocols for women presenting with GU symptoms, or at least for women presenting with only genital symptoms without urinary symptoms, should be evaluated. Most women (92%) presenting with GU symptoms had an abnormal UA result whether or not they had a positive urine culture. Although an abnormal UA result (mostly related to the presence of pyuria or a positive leukocyte esterase test) may occur with STI, collection contamination, and asymptomatic bacteriuria, providers frequently appeared to equate an abnormal UA result with the diagnosis of a UTI. We frequently noted comments in the medical records such as "UA with UTI present," "UA UTI present," and "UA consistent with UTI," even in the absence of any reported urinary symptoms. This misinterpretation of an abnormal UA result and the suboptimal performance characteristics of the UA in predicting a positive urine culture in this population likely contributed to the overdiagnosis of UTI and underdiagnosis of STI.

Second, although symptoms are integral to the diagnosis of UTI, we and others have found that in the ED setting, even traditional UTI symptoms alone do not reliably identify which patients have a lower UTI versus an STI versus other noninfectious GU syndromes (24). We believe the current clinical practice of empirical therapy for a suspected lower UTI (cystitis) without urine culture may be penny wise but pound foolish. Although there may be cost savings from not performing urine cultures, the costs of unnecessary antibiotic therapy and missed STI diagnoses may be greater, given concerns about increasing resistance in both uropathogens (25) and *N. gonorrhoeae* (26), adverse effects due to unnecessary antibiotic therapy, and the clinical and public health consequences of unrecognized and untreated STIs (risk of sexual partner infection, and increase risk of pelvic inflammatory disease, adhesions, ectopic pregnancy, infertility, and chronic pelvic pain). Until a more accurate rapid diagnostic test for UTI is available or a more accurate, well-validated, user-friendly clinical decision rule incorporating symptoms and UA results is available, increasing urine culture and STI testing and decreasing empirical therapy for a suspected UTI or STI in this population should be evaluated.

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